RESEARCH ARTICLE OPEN ACCESS

Review on Blood Vessel Detection in Retinal Image

Vandana Y. Koli[1], Mrs.Ashwini.G.Andurkar[2]
Research Student[1], Assistant Professor[2]
Department of Electronics &Telecommunication,
Government College of Engineering,
NMU, NH-6, Jalgaon,
Maharashtra-India

ABSTRACT
Assessment of retinal vessel provides information about the retinal abnormalities. This analysis helps to identify the various retinal diseases. Manual detection of blood vessel is the most tedious job and also it does not provide proper information. Automatic detection of blood vessel is easy, accurate and time saving operation. The assessment of blood vessel is done by using retinal image. To identify the disease and any change in vessel, segmentation of retinal image is necessary. Lots of methods are used for image segmentation. For accurate result several techniques are developed by different researchers. This paper provides an analysis of the existing automated blood vessel detection technique.

Keywords: - Blood vessel, post processing, Preprocessing, Retinal image Segmentation.

I. INTRODUCTION

Automatic detection of blood vessel is very significant for assessing retinal abnormalities and human identification. The blood vessel appearance provides information about diseases like diabetes, high blood pressure and arteriosclerosis. It causes the pathological alterations in the vessels like changes in retinal vasculature, increases in vessel tortuosity and blockages.

So the data regarding blood vessels in retinal images will help to diagnose the diseases. Manual detection of blood vessels is a very hard due to which automatic detection is needed. Automatic detection overcomes the drawbacks of manual detection. In manual detection, sometimes minor vessels are vanishes. Due to this an inaccurate result are obtained. Manual detection will consume maximum time.

Segmentation of blood vessels is not a single operation of automatic detection of blood vessels. The generalized block diagram shown in Fig.(1) will include some preprocessing and post processing steps. These step consist image enhancement, color space transformation, vessel central light reflex removal, background homogenization, filling pixel gaps and removing falsely detected isolated vessel pixels.

Section I of this paper provides the information regarding the necessity of automatic detection, importance of blood vessel detection and generalized vessel segmentation model. Section II gives the in depth analysis of blood vessel detection methods. Various algorithms and methods developed by different researchers are described in this section. Section III presents a conclusion remark based on the analysis.

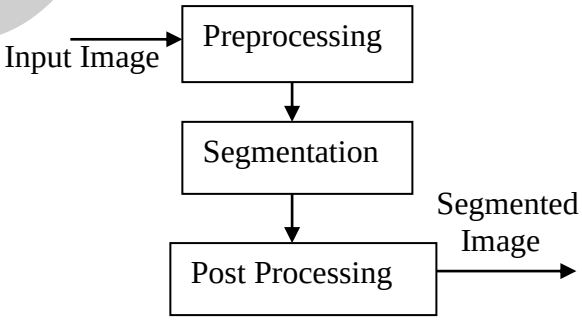

Fig. 1 Vessels segmentation model

II. RELATED WORK

A. *Preprocessing*

The images used for the detection purpose are publicly available retinal databases (DRIVE) [10].

The input images from these databases are RGB components. RGB image is not perceptually uniform. So the preliminary step of many researchers is the color space transformation.

To obtain the texture features Alauddin Bhuiyan, Baikunth Nath, Joselito Chua and Ramamohanarao Kotagiri, they apply transformation of original RGB to Gaussian and L*a*b* color space. They used first two component of Gaussian color space, Luminance from L*a*b* color space and green channel from RGB color space.[1]

To make the segmentation process easy and to decrease the computational time B.Sindhu, J. B. Jeeva[2] used Green channel component of original RGB color space. Some researchers uses gray scale image but only the luminance information is obtain from the color image after eliminating the hue and saturation, while maximum local contrast between the background and foreground is provided by the green channel image.

Also preprocessing step includes various techniques such as contrast enhancement, foreground/background differentiation, image de-noising, Vessel Central Light Reflex Removal, Background Homogenization etc. Image provides low contrast due to lighting condition, small dynamic range of imaging sensor. To improve the contrast between background and foreground image contrast enhancement is required. Shilpa Joshi, Dr. P. T. Karule have proposed contrast enhancement by using CLAHE technique [3]. Contrast Limited Adaptive Histogram Equalization is the technique which enhances the contrast adaptively by limiting maximum slope in the transformation function. Matlab Toolbox will help for this contrast enhancement.

Diego Marín, Arturo Aquino, Manuel Emilio Gegúndez-Arias, and José Manuel Bravo have implemented Vessel Central Light Reflex Removal and Background Homogenization [4]. For Vessel Central Light Reflex they used Morphological opening a three-pixel diameter disc, defined in a square grid by using eight-connexity, as structuring element. Due to nonuniform illumination fundus images contain background intensity variation. Means background pixels may have different intensity for the same image. To remove these background lightening variations, a shade-corrected image is accomplished from a background estimate. This image is the result of a filtering operation with a large arithmetic mean kernel.

B. Segmentation

According to the classification method, blood vessel segmentation of retinal images can be split into two classes. First is a supervised method which requires feature vector for each pixel and manually labeled images for training. Second one is an unsupervised method will include the matched filter responses, edge detectors, grouping of edge pixels; model based locally adaptive thresholding, vessel tracking, and morphology-based techniques.

Sameh A. Salem, Nancy M. Salem, and Asoke K. Nandi have developed the segmentation which was based on nearest neighbour concept [5]. They used NNCA classifier with one main difference that in proposed clustering algorithm training set was not necessary. Proposed algorithm is combination of supervised and unsupervised methods where a feature vector is generated for each pixel in the image, and then image pixels are clustered depending on these features without using a training set. NNCA is a modified version of the KNN Classifier. Also they compared the result of KNN classifier with NNCA classifier. The performance of developed algorithm was degraded due to random selection of pixels.

A supervised approach was developed by Diego Marín, Arturo Aquino, Manuel Emilio Gegúndez-Arias, and José Manuel Bravo, they extract the features and apply the classifiers. Gray level based and moment invariant features were selected by them. The results of this method were good. Important drawback is it requires a trained ophthalmologist and trained classifier for each and every data set [4].

Seyed Mohsen Zabihi, Morteza Delgir, and Hamid Reza Pourreza presented the algorithm for

vessel segmentation using color image morphology and local binary patterns [6]. In this algorithm the features were extracted using LBP and segmentation is done by using MLP classifier. MLP classifier is one of the neural networks type means the same critics as in KNN developed for MLP. Nilanjan Dey, Anamitra Bardhan Roy, Moumita Pal, Achintya Das developed a technique for segmentation; they used FCM clustering algorithm and median filter for subtraction background [7].

Another method was developed by Lili Xu, Shuqian Luo [8]. In this method binary image was constructed by using adaptive local thresholding and then large connected Components were extracted as large vessels. Support Vector Machine used for the detection for thin vessel afterwards tracking growth is applied to the thin vessel to form the entire vascular network.

Using unsupervised texture classification blood vessel was segmented. This algorithm was developed by Alauddin Bhuiyan, Baikunth Nath, Joselito Chua and Ramamohanarao Kotagiri [1]. Gabor filter bank was used for texture features extraction and segmentation was done by using FCM.

One more simple detection technique was implemented by B. Sindhu, J. B. Jeeva [2]. Morphological opening operation and thresholding was used for segmentation. The morphological opening operation was applied two times with different structuring element and two images were generated. To obtain the segmented image thresholding was applied to the subtracted image. Selection of structuring element was quite difficult for different images.

C. Post Processing

Segmentation step provides the segmented blood vessel from retinal image. But the image obtain after the segmentation is some time losses vessel pixels which causes inaccurate calculation. Due to this post processing step is required. The post processing step will generally includes filling pixels gap and removal of falsely detected pixels. In short post processing operation is used to eliminate the noise.

Seyed Mohsen Zabihi, Morteza Delgir, and Hamid Reza Pourreza used morphological erosion and dilation operation for smoothing the image and eliminating the noise [6].

Edge detection is used as the post-processing by Maria Garcia, Clara I.S., Maria I.L., Daniel Abasolo, Robert Hornero [9].

Diego Marín, Arturo Aquino, Manuel Emilio Gegúndez-Arias, and José Manuel Bravo developed an algorithm in which at least six neighbors classified as vessel points must also be vessel pixels and region connected to an area below 25 was reclassified as non-vessel [4].

III. CONCLUSION

Blood vessel detection in retinal image will help for identification of diseases and also for human recognition. As the whole detection technique is divided in three parts such as Preprocessing, Segmentation and Post processing will help to the new researchers. This paper focuses on different existing technique. Also gives an idea about the advantages/disadvantages of all those technique.

ACKNOWLEDGMENT

Authors would like to express sincere thanks and deep gratitude to Prof. S. O. Dahad, Head of E&TC Department who extended wholehearted co-operation to complete this work successfully.

Authors are also express deep and sincere gratitude to the principal, Government College of Engineering, Jalgaon for being a constant source of inspiration.

REFERENCES

[1] Alauddin Bhuiyan, Baikunth Nath, Joselito Chua and Ramamohanarao Kotagiri "Blood Vessel Segmentation From Color Retinal Images Using Unsupervised Texture Classification"IEEE, 2007.

[2] B. Sindhu, J. B. Jeeva "Automated Retinal Vessel Segmentation Using Morphological Operation and Threshold", International Journal of Scientific &Engineering Research, Volume 4, Issue 5, May 2013.

[3] Shilpa Joshi, Dr P.T. Karule" Retinal Blood Vessel Segmentation" International Journal of Engineering and Innovative Technology (IJEIT) Volume 1, Issue 3, March 2012

[4] Diego Marín, Arturo Aquino*, Manuel Emilio Gegúndez-Arias, and José Manuel Bravo "A New Supervised Method for Blood Vessel Segmentation in Retinal Images by Using Gray-Level and Moment Invariants-Based Features", IEEE Transactions on Medical Imaging, Vol. 30, No. 1, January 2011.

[5] Sameh A. Salem, Nancy M. Salem, and Asoke K. Nandi "Segmentation of Retinal Blood Vessels Using a Novel Clustering Algorithm" 14th European Signal Processing Conference (EUSIPCO 2006), Florence, Italy, September 4-8, 2006.

[6] Seyed Mohsen Zabihi, Morteza Delgir, and Hamid Reza Pourreza "Retinal Vessel Segmentation Using Color Image Morphology and Local Binary Patterns", 2010, IEEE.

[7] Nilanjan Dey, Anamitra Bardhan Roy, Moumita Pal, Achintya "FCM Based Blood Vessel Segmentation Method for Retinal Images", International Journal of Computer Science and Network (IJCSN) Volume 1, Issue 3, June 2012 www.ijcsn.org ISSN 2277-5420.

[8] Lili Xu, Shuqian Luo "A novel method for blood vessel detection from retinal images", BioMedical Engineering OnLine 2010.

[9] Maria Garcia, Clara I.S., Maria I.L., Daniel Abasolo, Robert Hornero (2009), 'Neural network based detection of hard exudates in retinal images', Computer methods and Programs in Biomedicine, Vol. 93, pp. 9-19.

[10] M. Niemeijer, B. vanGinneken, 2002 [Online]. Available: http://www.isi.uu.nl/Reseach/Databases/DRIVE/results.php.